PAPER-II: 3229
, ELECTRODYNAMICS, ELECTROMAGNETIC WAVES AND RELATIVITY

UNIT – I

Motion of charged particles in **E** and **B** fields: Case of cathode ray oscillograph, positive ray parabola, velocity selector, magnetic focusing, mass spectrography.

Faraday's law for electromagnetic induction: Faraday's law integral and differential forms; self-inductance of a solenoid and of a straight conductor, energy stored in an inductor and in the magnetic field. Displacement current; modified Ampere's law, Maxwell's equation for time-dependent electromagnetic field in vacuum and in material media, boundary conditions.

UNIT – II

Electromagnetic potentials: Magnetic vector potential **A** and scalar potential Φ. Poisson's equation for **A** in terms of current density, solutions for line surface currents. Coulomb and Lorentz gauge transformations, Lorentz law in terms of potentials.

Maxwell's equations and electromagnetic waves: Plane-wave solution for Maxwell's equation; orthogonality of **E**, **B** and propagation vector. Poynting vector; energy and momentum propagation, reflection and transmission at dielectric boundaries (normal incidence), polarization by reflection, Brewster's angle.

UNIT – III

Electromagnetic waves in conductors: Modified field equation; attenuation of the wave, reflection at and transmission through a conducting surface.Total internal reflection

Radiation from accelerated charges: Modification(Conceptual only) of Coulomb's law to include velocity and acceleration dependent terms in **E** field. Radiation from an oscillating dipole and its polarization. Radial and spherical power of electromagnetic radiation, Radiation pressure equation in free space and medium

UNIT – IV

The Lorentz transformations: Galilean transformations; Newtonian relativity, instances of their failure; electromagnetism, aberration of light, Michelson-Morley experiment; Einstein's basic postulates and geometric derivation of Lorentz transformations; invariance of Maxwell's equations, length contraction, simultaneity, synchronization and time dilation, Einstein's velocity addition rule, Doppler effect in light. Relativistic gravitational Red Shift

UNIT – V

Relativistic dynamics: Variation of mass with velocity, mass energy equivalence, relativistic formulae for momentum and energy.

The structure of space-time: Four vectors; invariance of an interval, time-like, space-like and light-like intervals, Minkowski space.

Relativistic electrodynamics: Electric field of a point charge in uniform motion; transverse components, magnetism as a relativistic phenomenon, transformation of **E** and **B** fields.

Recent developments in Physics including discussion of Nobel prizes in Physics (no questions to be set in the theory examination).

Text and Reference books:

1. D.J. Griffiths: Introduction to Electrodynamics, Prentice Hall of India, 1989.
2. Reitz and Milford: Introduction to Electrodynamics, Addison-Wesley.
3. A.M. Portis: Electromagnetic Fields
4. J.B. Marion: Classical Electromagnetic radiation (Academic Press)
5. R.P. Feynmann, R.B. Leighton and M. Sands: The Feynmann lectures in physics, Vol. II (B.I. Publications).
6. B. Saraf et al. : Physics through experiments Vol. I – EMF, constant and varying, Vikas Publishing House.
7. D.R. Corson and P. Lorrain: Introduction to Electromagnetic fields and waves, Freeman-Taraporevala, Bombay, 1970.
8. E.C. Jordan and K.G. Balmain: Electromagnetic waves and radiating systems, 2nd Ed., Prentice Hall of India, New Delhi, 1971.
9. Eletrodynamics ,Electromagetic Waves and Relativity (In Hindi) Kalra,Kakani and Bhandari